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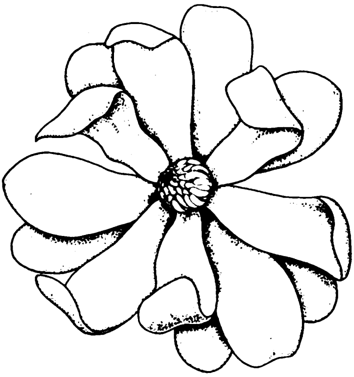

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OAKS OF PACIFIC SLOPE.

BY J. G. LEMMON.

ORIGIN.

The oak family is one of the highest, most modified, and extensively distributed lines of development in the vegetable kingdom. They are denizens of the temperate parts of the northern hemisphere, the chief source of hard-wood timber, of tannin, and of cork, the pride and favorite grove-maker of all civilized nations, the venerated trees under which the Druids worshiped and which bore on their "heaven-deformed limbs" the all-healing mistletoe. The oaks appeared on the earth, the geologists tell us, in the late cretaceous and early tertiary periods, that is, three long ages after the advent of the larger but less highly organized cone-bearers, and nearly coeval with the graceful, heat-loving palm family.

The oaks were early distributed thoughout eastern Asia, southern and central Europe, and in North America, the greater portion of the latter inhabiting a region the center of which was far northward of the present headquarters of the family. In this age they are found on the high plateau of Central America and southern Mexico, where are now flourishing scores of species. From thence several extend northward, inhabiting Mexico and the United States, diminishing in number of species to six in Canada and one in British Columbia.

Oaks are recognized at sight, whether living plants of the present age or vestiges of early species and found as fossils in the rock strata of the earth, by the peculiar, thick, cup-like receptacle of the fruit holding a solitary, top-shaped nut—the acorn. A brief description of oaks might be, "Plants that bear acorns."

VITALITY OF THE OAKS.

The vitality of the oak is very great, even under adverse circumstances. The aboriginal inhabitants, whether by carelessness or design, used to burn off annually the whole herbage from their hunting-grounds. While this treatment killed off the tender, highly-organized plants, the oaks broadened out their root-caps underground, and from their borders sent up year after year strong sprouts, that, when forest-burning ceased, eighty to one hundred years ago, have grown to become vigorous trees. Also, the acorns germinating in the shade of trees like the cone-bearers, are kept alive from year to year by a few leaves, while large roots are being developed, and at length, strong, aggressive saplings bearing broad, absorbing leaves take possession of the ground to the exclusion of predecessors and newcomers. The oak thus replaces the pine, to the surprise of some observers, and continually, as the pine forests of the eastern states are cleared away, the rugged black oaks, often the little, worthless scrub oaks, seize upon the dominions.

Forests of oak extend thus into the naturally treeless western portion of the Mississippi Valley, reclothing the prairies and the partial deserts, welcomed and protected by the settlers. The kind of oaks that survive most in forests of many species is not, generally, the most valuable,—the white oak group,—but the coarse-grained, usually worthless black oaks. And this is accounted for very readily; the bitter, astringent qualities of the acorns of the black oaks are left by swine, squirrels, and birds alike, to germinate, while they hunt industriously for the sweet, nutritious acorns of the white oaks.

VALUABLE PRODUCTS.

The family of oaks, comprising the botanical genus of *Quercus,* is distinguished, not only for their generous shade, owing to their usually large and numerous leaves, but several of the arboreal species of white oak are celebrated as timber trees. Of these the most valuable in various manufactures are *Quercus alba,* the white oak of the northern states, *Q. virens,* or live oak of the southern states, and the *Q. platanoides,* or white oak of the middle western states, while others, including the *Q. densiflora,* the tan-bark oak of the California coast, are prized for the yield of bark collected by the ton annually for making leather. One peculiar species, *Q. suber,* the cork-bark oak of southern Europe and northern Africa, yields the soft, spongy bark from which is derived the cork of commerce. Also from early times oak galls caused by the punctures of insects, have been used for dyeing, for making ink, and, indeed, for wound-dressing and for medicine.

DISTRIBUTION.

While many species of oak are doubtless unknown, from the nature of the regions they affect (the high, broken mountain slopes, mostly unexplored), there have been discovered and described over three hundred species.

Europe has comparatively less than similar regions east and west of it. The number in North America north of Mexico already known, is about fifty. The American species are mostly grouped in two regions,—the eastern Atlantic slope and the extreme western Pacific slope.

Of the eastern oaks three species—the red oak, the bur oak, and the white oak—are found at the northern limit in northwest Ontario.

Southward the species increase to ten in southern New England, while the gulf states contain some nineteen species; but the central eastern portion of the Mississippi Valley contains more individual trees to the acre—and they attain the largest size there—than elsewhere in America.

Leaving the prairies and approaching the high, dry, and cold mid-continental plateaus, the oaks—even the dwarf varieties—are almost entirely absent.

PACIFIC SLOPE A UNIQUE REGION.

The Pacific slope of North America comprises, of course, all that part of the continent west of the Rocky Mountains; but for the purpose of this paper, only the American portion north of the Mexican boundary will be considered. This region includes two territories, five states, and a portion of three others. It happens that this large region, owing to the continuity of the high Rocky Mountain range—without a break or low pass from the Arctic Ocean to the Gulf of Tehuantepec—is possessed of a practically distinct flora. Not a pine, spruce, fir, cedar, or cypress, not an oak, ash, walnut, or maple of the Pacific slope, is identical with those beyond the Rockies. So we have here a compact, definite, and nearly special creation.

Because the Mexican boundary is not a high mountain range, but only a straight surveyor's line across a continuous plateau, the floras of Mexico and the United States commingle here, five Mexican oaks dripping over the line into New Mexico and Arizona. Three local species arise there, too, sharing the highlands with them; but from thence northward, inhabiting the humid, forcing climate of California and Oregon, to Washington and British Columbia, the thirteen species are all our own,—the largest and noblest of them being in the great valley of California.

PRINCIPAL PUBLICATIONS OF AMERICAN OAKS.

"Sylva of North America," a fine quarto volume, was published 1817, by Andrew Michaux, as the result of the explorations of his father and himself in the then little-known region of America. It contains descriptions with excellent colored plates of the foliage and fruit of twenty-six species of oak inhabiting the region east of the Mississippi River. The continuation of the Sylva, 1857, by Thos Nuttall, added four more, all from the Pacific slope; *Quercus agrifolia,* our first discovered, storm-beaten Live Oak; *Q. lobata* the noble Valley Oak; *Q. Garryana,* the fine Pacific white oak; and *Q. dumosa,* the low, Bushy Scrub Oak, or chaparral.

"The Oaks of the United States," a scholarly paper, read 1876 before the Academy of Sciences at St. Louis, Mo., by Dr. Geo. Engelmann, described forty species, including nine more western ones. In 1880 Dr. Engelmann elaborated the genus *Quercus,* the oaks, in Watson's second volume of "Botany of California." It included descriptions of eleven western species. No illustrations accompanied either of these papers.

"Forest Trees of California" appeared 1882, published by Dr. A. Kellogg, one of the seven founders of the California Academy of Sciences. It includes seven species of oak, lovingly described by the doctor in appreciative but non-scientific language, interspersed with poetical quotations. For many years afterward, Dr. Kellogg devoted odd hours to accurate drawings of oak branchlets—the foliage, flowers, and fruit—which were utilized by a later author.

"West American Oaks," appearing 1889, is a folio volume in two parts, by Prof. E. L. Greene, then of the University of California. The first part is a memorial tribute to the labor and worth of Dr. Kellogg, the illustrations being those cited above as the painstaking work of the doctor. The species, seventeen in number, include *Quercus Morehus,* of Kellogg, and a new and tenable species described under the name of *Q. Engelmanni.*

Dr. Kellogg's drawings of species outside of California were made from specimens collected in Arizona and New Mexico by the writer, as noted by the pencil of Dr. Kellogg and the pen of Professor Greene. The second part presented several proposed new species, illustrated by drawings by Geo. Hanson.

"Forest Trees of North America," being vol. 9 of the Tenth Census of the United States, appeared 1884, by Prof. C. S. Sargent, director of Arnold Arboretum. This large folio volume contains extended discussions of trees from many points of view, describing forty-eight oaks, sixteen of them inhabiting West America. No illustrations.

"Arborescent Flora of the United States" is the title of a classified list or bulletin from the Agricultural Department at Washington, issued 1897, by George B. Sudworth, dendrologist of the Division of Forestry. The publication of this painstaking list gave Mr. Sudworth the opportunity to apply the new rules of priority in the presentation of names, whereby he becomes the author of scores of new designations of well-known trees, including *Sequoia Washingtoniana,* for our Giant Sequoia.

This volume was followed, 1898, by a Check List of United States Forest Trees, their Names and Ranges, including seventeen species of oak from West America.

Latest and most extensive of all is the "Sylva of North America," by Prof. C. S. Sargent. This is a series of twelve magnificent folio volumes, which began to appear in 1891. The seventh volume, published 1895, treats of the *Cupuliferae,* including the oaks. With elaborate descriptions and foot-notes of each species and ample illustrations of the foliage, flowers, and fruit, these twelve ponderous volumes, comprising all the American trees known, must long remain the most valuable treatises upon the subject,—a conspicuous and fitting monument to the industry, erudition, and perseverance of their author. There was but a limited edition printed, the sets costing to universities and public libraries twenty-five dollars per volume. Sargent describes fifty species of oak, twenty-one of them in West America.

No illustrations of entire trees or lower portions of tree trunks—as instructive in this as in the conifer family—are given in any of the works above cited. In time the public will demand a fully illustrated work, especially of our western trees, at once a supreme delight to the eye and affording a complete comprehension by the mind of the beauty and value of these master products of the earth.

The varying number of western oaks described in the nine volumes cited—ranging from four species in Nuttall's Sylva to twenty-one in Sargent's—indicates not only the advance of discovery in forty years, but also the varying number of characters deemed necessary for specific rank by different botanists, some requiring more than others.

In general, Professor Greene is very radical, often publishing new species on a few characters, while Professor Sargent is conservative, often uniting many forms under one general description.

THE OAKS, A MEMORIAL FAMILY.

The oaks may well be called the memorial family; no other genus of plants of the same number of species has so many in it named for persons. There is good reason for this. The species are so widely distributed through the north temperate regions, the very regions inhabited by persons of appreciation, and they are usually so beautiful and long-lived, that they speedily become well known and great favorites; hence, it is a high honor to have a species of oak named for one by a fellow-botanist.

The whole number of species of oak in the United States is forty-three; the number named for persons (the discoverer or one who has studied them closely) is fifteen. The number on the Pacific slope is twenty-one, of which more than half (twelve) are memorial oaks.

In the descriptions following (this being more a popular than a scientific treatment of the subject), some attention is given to the discoverers and describers of species; in some instances, brief biographies are presented.

The writer, although he has explored the Pacific slope for many years, collecting specimens and studying trees, was not fortunate enough to be the very first botanist to find an unknown oak; hence, he is all the more at liberty to write of the fortunate immortals whose names are commemorated by a dozen of our magnificent or otherwise interesting western oaks.

CONSPECTUS.

Genus Quercus (The Oaks).

Monœcious trees or shrubs of northern temperate and warm regions, of about 300 known species, especially abundant in eastern Asia and in Mexico. Wood mostly hard and durable. Leaves alternate, simple, pinnate-veined, usually broad and flat. Fruit a scaly, thickened cup sustaining a solitary, one-celled nut—the acorn. Staminate flowers in slender aments, pendulous (erect in one species) bracts caducous. Pistillate flowers solitary or scattered, consisting of an ovary with 5 to 8 styles or sessile stigmas; ovules six, but only one is fertilized, becoming the thick, fleshy, two-lobed seed filling the nut, the rudiments of the five abortive ovules remaining near the base, or along the side, or prolonged to the apex of the seed.

WHITE OAKS.

A. Bark pale or light-colored, wood nearly white; stamens 6–9, stigmas sessile or nearly so; acorns mostly soft-shelled, seeds edible; abortive ovules basal or rarely lateral; 16 species.

I. Maturation annual; nut glabrous within (except *Q. Emoryi*); abortive ovules basal.

(a) Leaves falling in autumn (except *Q. Sadleriana*).

* Leaves yellow-green and large.

(1) Lyrate or sinuate-pinnatified. Acorns large.

Leaves oblong or obovate, deeply lobed, usually stellate-pubescent above, pale and pubescent below; nut conical elongated, 1¼ to 2 inches long. Great Valley Oak . . . . . 1. *Q. lobata.*

Leaves obovate or oblong, coarsely pinnatified; green and lustrous above, branchlets thick; buds large and very hairy; nut oval or oblong, 1 to 1¼ inches long. Pacific Post Oak. 2. *Q. Garryana.*

Leaves obovate or oblong-lanceolate, 3 to 5 inches long, lobed or pinnatified and shining above, pubescent below; branchlets and buds tomentose; nut 1 to 1¼ inches long. Gambel Oak. . . . . 3. *Q. Gambelii.*

Leaves obovate, 2 to 5 inches long, acutely lobed, pubescent below; nut oblong, large, 1 to 1¼ inches long, cup shallow. A small shrub. Brewer Oak. 4. *Q. Breweri.*

(2) Coarsely sinuate-toothed.

Leaves oval to obovate, thick, coriaceous, pale below; persisting during the winter. A low shrub. Sadler Oak . . . . 5. *Q. Sadleriana.*

** Leaves blue-green and small.

Oblong, sinuate-dentate, entire or lobed, or spinescent-toothed, 1½ to 2 inches long, glaucous above, pubescent below; nut small, ovate, ½ to 1 inch long. Rocky Mt. Oak. . . . . 6. *Q. undulata.*

Oblong, entire or sinuate-lobed, conspicuously light-blue above, pubescent below; nut large, oblong or ventricose, ¾ to 1½ inches long. Blue Oak, Douglas Oak. 7. *Q. Douglasii.*

(b) Leaves mostly persistent until the following spring. (Evergreen Oaks.)

* Leaves blue-green.

Oblong or obovate, usually obtuse and rounded at apex, entire or remotely dentate; nut ovate, ¾ to 1 inch long, Evergreen or Englemann Oak. . . . . . 8. *Q. Engelmanni.*

Ovate or oval, usually cordate at base, entirely or remotely spinulose-dentate; nut small, ovate. Oblong-leaf Oak . . 9. *Q. oblongifolia.*

Oblong to broadly-obovate, cordate or rounded at base; spinose dentate, reticulate-venulose below; branchlets thick, rigid; nut small, nearly globular, ½ inch long. Arizona White Oak. . . . . 10. *Q. Arizonica*, n. sp.

Broadly obovate, cordate, usually rounded and obtuse at apex, repandly spinose-dentate, coarsely and conspicuously reticulate-venulose below; nuts spicate, on long, slender peduncles, small, ½ inch long. Net-leaf Oak . . . . . 11. *Q. reticulata.*

Ovate-oblong or oval, small, ½ to 1 inch long, acute at apex, entire or remotely spinose-dentate; branchlets rigid; nut small. New and rare. Toumey Oak. . . . . 12. *Q. Toumeyi*, n. sp.

** Leaves dark green.

Oblong or obovate, small, entire or sinuate-toothed or lobed, pubescent and often pale below; nut small, ovate or oblong, ½ to 1 inch long. Scrub Oak. 13. *Q. dumosa.*

Oblong-lanceolate, entire or repand-serrate, coriaceous; nut small, narrow, and long, ¾ to 1 inch, edible. Emory Oak, "Biotes." . . . . 14. *Q. Emoryi.*

II. Maturation biennial; nut silky-tomentose within; abortive ovules basal or lateral.

(c) Leaves persistent. (Live Oaks.)

Oblong acute or cuspidate, entire, or dentate, or sinuate-toothed, fulvous-tomentose, ultimately pale on lower surface; nut oblong, 1 to 2 inches long, scales of cup usually clothed with short, stiff yellow hairs. Canyon Live Oak, Maul Oak. . . . . 15. *Q. chrysolepis.*

Oblong-lanceolate, acute, crenate-dentate, or entire, conspicuously veined, tomentose beneath; cups and acorns very large. An insular species. Cotton-leaf Oak. . . . . . 16. *Q. tomentella.*

BLACK OAKS.

B. Bark dark, often nearly black, wood reddish; stamens 4 to 6, stigmas on long styles; nut mostly hard-shelled with bitter astringent seeds, inner surface of nut silky-tomentose; abortive ovules toward apex of the seed; 4 species.

I. Maturation annual.

Leaves usually persistent until the appearance of the new crop.

Oval, orbicular or oblong, entire or sinuately spinose-dentate; nut ovate or elongated to an acute point, 1 to 1½ inches long. Field Oak. . 17. *Q. agrifolia.*

II. Maturation biennial.

(a) Leaves persistent. (Live Oaks.)

Lanceolate-oblong or elliptical, entire or spinosely-dentate toward the apex, coated with pale or fulvous tomentum on lower surface; veins very prominent; nut deeply inserted in the small hemispherical cup, ovate to oblong, ½ to 1 inch long. White-leaf Oak . . 18. *Q. hypoleuca.*

Oblong-lanceolate, 1 to 2 inches long, entire or sinuately dentate, dark green and lustrous above; firm, coriaceous; nut slender, tapering, lineate, ¾ to 1½ inches long. Live Oak. . . . . 19. *Q. Wislizeni.*

(b) Leaves deciduous.

Oblong or obovate, deeply lobed, lobes tapering, acute or broad and obovate, repand-dentate or entire, glabrous or pubescent when young; nut large, oblong, often mostly concealed in the broad scaly cup. Black Oak. Kellogg Oak. . . . 20. *Q. Californica.*

Pasania (Chestnut Oaks).

A sub-generic name given by Oersted to a group of Chestnut-like Oaks of eastern Asia, one species only being on the Western Continent and that in California. Leaves oval or elliptical, coarsely serrate, often large, 3 to 5 inches long, staminate flowers in long aments, large and erect; nut large, often subtriangular at apex, tomentose, 1 to 1½ inches long; shell very thick and hard. Chestnut Oak. Tan-bark Oak. . . . . 21. *Q. densiflora.*

DISTRIBUTION OF WESTERN OAKS.

IN CALIFORNIA 13 SPECIES.

Q. Lobata, *Garryana*, *Breweri*, *Sadleriana*, *Douglasii*, *Engelmanni*, *dumosa*, *chrysolepis*, *tomentella*, *Wislizeni*, *agrifolia*, *Californica*, and *densiflora.*

CALIFORNIA AND NORTHWARD, 4 SPECIES.

Q. Garryana, *Sadleriana*, *Californica*, and *densiflora.*

ONLY IN CALIFORNIA, 4 SPECIES.

Q. Lobata, *Breweri*, *Douglasii*, and *Engelmanni.*

CALIFORNIA AND SOUTHWARD, 5 SPECIES.

Q. Dumosa, *chrysolepis*, and var. *Palmeri*, *tomentella*, *agrifolia*, and *Wislizeni.*

MEXICAN OAKS, REACHING ARIZONA AND NEW MEXICO, 7 SPECIES.

Q. Gambelii, *undulata*, *oblongifolia*, *reticulata*, *Emoryi*, *tomentella*, and *hypoleuca.*

ONLY IN ARIZONA, 2 SPECIES.

Q. Arizonica and *Toumeyi.*

OAKS OF CALIFORNIA.

ALSO OREGON AND WASHINGTON.

1. **Quercus lobata.** Née, 1801. VALLEY OAK.

Monarch of the Pacific tribe, the largest and most conspicuous of the West-American oaks, is 60 to 80, often over 100 feet high, with a trunk 5 to 8, often 15 to 20 feet in diameter. Dividing often near the base, the large branches radiate to form a broad head, often 100 to 200 feet across. Peculiar for its large, oblong, deeply-lobed, shining leaves, its long, slender, often drooping, sterile branchlets, resembling a weeping willow, and for its very long, narrow acorns, 1¼ to 2 inches long. Hooker's Oak, on General Bidwell's farm near Chico, Cal. (named in honor of Sir Joseph Hooker, who visited the tree, with Dr. Asa Gray, in 1877), was then 150 feet in spread of branches, and the trunk was 6½ feet in diameter. In Napa and Capay Valleys are some oaks over ~~2~~0 feet in 10 diameter, and with a spread of branches that might shelter a regiment of soldiers.*

Found in the valleys of western California, between the Sierras and the ocean from Redding to Tejon Pass. Seldom forms a grove by itself, but often with the coast Live Oak and the foot-hills Blue Oak, it forms large, orchard-like parks. Small, slender trees, with never a drooping limb, line the banks, in places, of the low coast and valley rivers. This oak is the "Roble" of the Spanish Californians and Mexicans.

2. **Quercus Garryana.** Hook., 1839. PACIFIC POST OAK.

Noble trees of the northwest, 60 to 70 feet high, with erect branches, forming a compact head. Noted for its unusually large dark green leaves and stately trunks not concealed by drooping branchlets, as in the Valley Oak. Readily distinguished by the large and very hairy branchlets and buds. Has a long but narrow habitat, or range, near the northern coast of California, the largest trees but a few miles from the ocean, thence extending northward across western Oregon and Washington to the borders of British Columbia.*

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*The first voyager that has given us his impressions of this noble tree is Vancouver, who entered the Bay of San Francisco 1792, and, casting anchor, prepared to visit the Mission at Santa Clara. "We had not proceeded far," he writes, "when we entered a country, I little expected to find. For about twenty miles it could only be compared to a park which had been originally closely planted with the true old English oak. The underwood—if ever there were any—had been cleared away, eaving the stately lords of the forest in complete possession of the soil, which was covered with luxuriant herbage and beautifully diversified with pleasing eminences and valleys, which, with the range of lofty, rugged mountains that bounded the prospect, required only to be adorned with the neat habitations of an industrious people to produce a scene not inferior to the most studied effects of taste in the disposal of park grounds."

A year earlier the Spanish expedition, under Malaspina, had visited the coast, and his accompanying naturalist, Prof. Louis Née, collected specimens of this and other trees, publishing, at Madrid, 1801, a description of this and of the Field Oak, giving each their appropriate names.

The form called *Q. Gilberti,* Greene, founded upon dense thickets of oak on the islands and shores of Puget Sound, Sargent regards as a depauperate form of this species with nearly globular, crumpled leaves, the flowers and fruit unknown. Also, *Q. Jacobi,* A. Brown, with ovate acorns and slightly different leaves, is thought to be but another aberrant form.

3. **Quercus Douglassii.** Hooker and Arnott. 1841. DOUGLAS OAK, BLUE OAK.

This local California oak is readily recognized by its small light green or bluish leaves, and its very light gray colored bark on trees growing on exposed hillsides, or darker in sheltered places, and by its location, throughout middle California, becoming trees 20 to 30 feet high on the foot-hills and slopes of the Coast Ranges and the western slope of the Sierra Nevada.**

The large acorns of the Douglas oak are collected by the "Carpintero," or carpenter woodpecker (*Melanerpes formicivorus*), which excavates holes in the bark or exposed wood of trees in which to insert these acorns, leaving them there until the larva of a beetle which infests them has grown large enough to furnish his store-room with a season's bounteous supply of fresh canned meats. The acorns of other white oaks, notably those of the Valley Oak, are treated similarly by this provident bird.

This very showy, gray-leaved oak was first collected near Monterey by David Douglas,* the indefatigable and successful Scotch botanist and explorer, in 1832. The species was named in his honor by Hooker and Arnott, in 1841.

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*The type of the species was discovered by Dr. Archibald Menzies, surgeon of Vancouver's Expedition to Puget Sound, but not published until after its discovery by Douglas, who named it in honor of Nicholas Garry, secretary of the Hudson Bay Company; but Dr. William Hooker published the description 1840, hence he is to be credited as the author of the name, according to the modern rules.

**In connection with his description of the Douglas Oak in Sylva of North America, Professor Sargent offers this graceful tribute to the intelligent services of one of California's most industrious and scientific workers. "Miss Eastwood, the curator of the Botanical Department of the California Academy of Sciences, has been of great assistance to me with her unrivaled collection of California oaks, made mostly in the southern part of the state." The writer has learned that the number of papers of mounted oak specimens in the Academy Herbarium exceeds four hundred—mostly the collection of Miss Alice Eastwood, whom Prof. P. A. Rydberg purposes to justly honor by naming a pretty oak of her recent discovery in southern Utah, *Quercus Eastwoodæ*, sp. nov.

4. **Quercus Chrysolepis.** Lieb. 1849. GOLDEN LEAF OAK, MAUL OAK.

This cañon-loving, dark-foliaged oak of the western slopes of the Sierra Nevada, where it often becomes a tree 20 to 40 feet high, diminishing to a low-spreading bush on the higher elevations, is generally at once recognized by its long, narrow leaves, colored yellow beneath when young, with fulvous tomentum or yellow plant hairs. The usually large acorn cups are also densely clothed with short, brittle, golden hairs that leave yellow stripes upon the clothing of intruding visitors. The timber of this tree is strong and durable, and is used for various manufacturing purposes.

The typical form of this species was first collected by Karl Theodor Hartweg, "on the hills back of Monterey," in 1846. Mr. Hartweg was one of the earliest explorers to visit California, with Mr. Lobb, 1846 to 1850, collecting mostly in the vicinity of Monterey Bay, finding many plants the seeds of which were sent abroad for propagation.

Variety, *vaccinifolia* (Kellogg), Engelm., 1877. ALPINE OAK.

This Alpine oak is the low, bushy form found nearly up to timber line on the Sierra peaks, with small, pale, nearly smooth leaves and acorn cups, and was considered a distinct species by Dr. Kellogg, but intermediate forms grade down to the typical tree in its best estate.

Variety, *Palmeri* (Engelm.), Sargent, 1879. PALMER OAK.

Near the Mexican boundary line in San Diego, Cal., Dr. Edward Palmer** discovered, 1875, dense thickets of a scrubby oak with rigid branchlets, leaves oblong or mostly orbicular, coriaceous, and spinose-dentate, acorns ovate acuminate, 1½ inches long. Regarded by Engelmann and Greene as a good species, but referred as a variety by Sargent.

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*No description of western trees, especially of the cone-bearing family, can be written without more or less allusion to Mr. Douglas. A brief account of him (in connection with his discovery of the Sugar Pine) is given in the report of the writer as the botanist for the 2d Biennial Rep. of the Cal. State Board of Forestry, pages 81-82, 1887–1888. He discovered seven of our cone-bearers, one of the noblest of which, the Douglas Spruce (though sparsely collected before), was given his name, 1855, and it is still retained for the popular name of the tree.

**Edward Palmer was born at Wilton, Eng., 1833. His father was a florist, giving the son an early knowledge of flower culture. He came to America in 1849, settling at Cleveland, Ohio, occupied as a private nurse for a gentleman whose friend, having fine gardens, afforded young Palmer many privileges of examination and study. In 1853 he was appointed collector of an expedition sent to Paraguay. Two years

5. **Quercus Engelmanni.** Greene, 1889. ENGELMANN OAK.

This evergreen oak is but little known, owing to its limited home—a narrow belt about 50 miles wide in southwestern California, from Sierra Madre to within 15 or 20 miles from the coast. It is a handsome tree, becoming 40 to 60 feet high, with a diameter of 2 to 3 feet. The branches are stout and spreading, bark light gray and deeply fissured, the leaves blue-green and oblong, 2 to 3 inches long. Trees of this species were seen by Dr. C. C. Parry as early as 1850. Others collecting specimens of it since have referred the species to a similar tree in Arizona, *Q. oblongifolia,* but our tree has darker bark, thicker leaves, larger acorns, and the seeds are conspicuously yellow. A fine California oak, recently described (1889) and figured in West-American oaks, by Prof. Greene, and dedicated to that most profound student of American oaks—Dr. Engelmann.*

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later returned to Cleveland and obtained some instruction in medicine. In 1864 he came to California, connecting himself with the Geological Survey of California, and was stationed at San Diego. Wishing to take some part in the Civil War, he went back east and was appointed hospital steward in a Colorado regiment, and served with it for a year, when he was appointed contract surgeon and stationed in Kansas, where he began the real work of his life as a collector of objects in natural history. Leaving the army, he engaged in extensive exploration. Employed by the Smithsonian Institute and the Agricultural Department for many years, he collected several important and valuable plants from the shores of the Gulf of Mexico and many interior Mexican states, as well as in the southern portion of the United States. Dr. Palmer's arduous labors and privations have been recognized by the dedication of a genus *Palmerella,* growing near Santa Barbara, and by species of plants in many other genera, including this of the Oaks.

*Dr. George Engelmann, born 1809, at Frankfort-on-the-Main, early became a teacher, entered Heidelberg, took a degree in medicine at Wurzburg, studied natural history with Agassiz and Braun, came to America, and soon established himself in St. Louis, where he became a very successful physician, from which absorbing profession he snatched a few hours from time to time for the study of botany, choosing the most difficult groups of plants, such as Cactacea, Cuscuta, Yucca, Agave, and the Conifers generally. Nearly all his life a closet botanist, but visiting Europe several times to consult specialists and examine herbaria, it was only toward the end of his career that he was able to see with his own eyes living individuals of the many western plants he had first made known to science. He visited California 1878, with Professor Sargent and Dr. Parry, to study our trees; their size and number filling him with amazement. Dr. Engelmann was a many-sided man; he kept a careful record of meteorological data for forty-eight years—practically a half century—in the hope that he could discover some periods of hot or cold, of wet or dry seasons, but was compelled to state that he "had learned nothing of the laws of nature in regard to weather." After a long life of almost matchless activity and research, the end came 1884.

Dr. Engelmann's writings, collected and published by his son, make a thick volume on subjects that left but little to learn by others. His name will be preserved by the genus *Engelmannia,* a large, handsome yellow flower of the western

6. **Quercus agrifolia.** Née, 1801. FIELD OAK, "ENCENA."

This well-known, dark-barked, prickly-leaved, low-browed oak is common in the coast region of central California, especially about the Bay of San Francisco, where it attains its largest size, 20 to 40 feet in height, if sheltered from the ocean gales; but in exposed localities the saplings are early assaulted by the winds, and as the tree divides near the base into diverging branches, they are overborne, those on the lea side often resting their elbows on the ground, while the branchlets are prolonged year after year, in the direction of least resistance away from the sea. Trees are known to creep in this manner fifty feet or more. Owing to its nearness to Monterey Bay, one of the first harbors on the coast to be visited by European explorers, this was the first oak discovered, 1791, by Prof. Louis Née, a French botanist with the Spanish expedition of Malaspina. Aside from the publication at Madrid, 1801, of this oak with the Valley Oak and other plants collected on this expedition, little is known of this, the first naturalist to make known to the reading world in technical language the vegetable wealth of the Pacific slope.

Prof. Sargent, in his Sylva, writes of this oak: "The valleys and low hills of the California coast owe their greatest charm to this oak tree, which, dotting their covering of vernal green or their brown summer surface with its low, broad heads of pale, contorted branches, and dense, dark foliage, gives them the appearance of incomparably beautiful parks." The classic oaks of Berkeley belong to this species.

7. **Quercus Wislizeni.** A. de Candolle, 1864. LIVE OAK.

A fine black oak, often 50 to 80 feet high, trunk short but frequently thick, 4 to 6 feet in diameter, branches spreading, forming a rounded top; bark thick, 2 to 3 inches. Headquarters in middle California, extending from the lower slopes of Mt. Shasta southward through the Coast Ranges to Santa Lucia Mountains, shrubby forms continuing on the southern mountains to the peninsula of California, also on a few of the Channel Islands. On the western slope of the Sierra Nevada it mingles with the Douglas Oak, in sharp contrast of color; and, lower down, with the Valley Oak, from which its small, oblong, entire, dark green leaves readily distinguish it. At flowering-time, as Prof. Jepson writes, "The aments from a terminal bud or a cluster of buds are often so numerous and large as to transform the appearance of the tree, in April or May, imparting to the crown a singularly soft and billowy yellow-green appearance." First discovered by Fremont in the Sierra

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plains; by the handsomest of the spruce trees of the Rocky Mountains; by a conspicuous cactus of the deserts of the southwest, and by hosts of smaller plants; and also it will be held in honored remembrance so long as the trees of the New World remain a subject of interest to students.

Nevada, but described from specimens collected by Dr. F. A. Wislizenius, on the American River. This beautiful oak commemorates the labors of another early and successful explorer of western America, especially the southern portion of New Mexico and Arizona, and in Mexico, where the doctor collected many plants new to science, including a curious genus of the Capar family, named *Wislizenia,* in his honor.

8. **Quercus Californica.** Cooper, 1859. KELLOGG OAK, BLACK OAK.

This most interesting of the California black oaks is at once distinguished by its very dark, smooth bark (while young), and its large, deeply-lobed leaves, each lobe tipped with a ¼-inch bristle. With headquarters in northern California and southern Oregon, where it often attains a height of 80 to 100 feet and a diameter of 2 to 4 feet, this tree ranges from the basin of McKenzie's River, in northern Oregon, southward through the Coast Ranges and along the western slope of the Sierra Nevada, which it ascends 7,000 to 8,000 feet; to the San Bernardino Mountains and others of San Diego County, its limit being on the Cuyamaca Mountains. Low, scrubby bushes with small leaves and acorns, not reported hitherto by botanists, were among the first of the discoveries of the writer in Sierra Valley, on the east slope of the Sierra Nevada, and may be designated as var. *transmontana.*

This noble tree was first collected by Hartweg, 1846, near Sonora. Dr. John Torrey referred it, 1856, to *Quercus tinctoria,* as var. *Californica.* Dr. J. S. Newberry, deciding it to be a distinct species, named it, 1857, *Quercus Kelloggii,* in honor of California's pioneer botanist, Dr. Albert Kellogg.* Under the rules of nomenclature demanding that the first applicable name given it must be accepted, *Californica* must be the specific name of this oak—and, incidentally, it was published as *Quercus Californica* by Dr. Cooper, 1859. However, California botanists, hailing with delight the name of *Kelloggii,* have held to its use until a late date; while the general public has indelibly fixed the popular English name of this interesting tree as the "Kellogg oak."

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*"Good Dr. Kellogg," as he was called, well deserved this honor, being a true-hearted, industrious, and successful botanist. Coming to California in 1849, he had matchless opportunities in botanical research. With seven others he helped to found the California Academy of Sciences and early became curator of the herbarium, a position held until the time of his death, which occurred 1887, at the age of seventy-four years. He made several botanical excursions up and down the coast, including one to Alaska. Discovering many plants new to science, he had the privilege of naming a marked variety of the Kellogg Oak (*Q. Californica*, var. *Morehus*), three species of ceanothus, three of lily (including the magnificent Lady Washington of the High Sierra), and scores of smaller plants. A Galium-like genus, *Kelloggia*, found on the mid-Sierra slopes, was dedicated to him by Dr. Torrey, and this with his many botanical papers will preserve the memory of this gentle-spirited lover of nature as long as California plants are collected and studied.

9. **Quercus densiflora.** Hooker and Arnott. 1841. TAN BARK OAK. CHESTNUT OAK.

This beautiful and curious species—resembling a chestnut as much as it does an oak—becomes in its headquarters along the streams in Marin County, a tree 40 to 60 feet high, with a trunk 2 to 5 feet in diameter. It ranges from Umpqua River, in southern Oregon, where it is reduced to a small tree but a few feet high (var. *echinacea*), southward along the Coast Ranges to the Santa Inez Mountains, of southern California; also, it is found on the west slope of the Sierra Nevada to an elevation of 4,000 feet. Peculiar for its large, long (3 to 4 inches), and erect male flowers, its chestnut-like leaves, and the characters of the acorn cup, the scales of the typical oak being replaced by fleshy awl-shaped spurs, ¼ to ½ inch long, divergent or recurved. The nut, also, is peculiar, being somewhat triangular, looking from above, and it is covered with a dense coat of very short brown hairs.

Whenever this species attains the dimensions of a tree, small or large, as Dr. Kellogg remarks, "It is the most regular and symmetrical of oaks;" and Prof. Sargent states: "No oak of western America excels the best representatives of this species in massive beauty of outline or in richness of color. In early spring the elongated tender shoots and unfolding leaves, coated with white hairs, appearing like masses of flowers against the dark background of older leaves, light up the coniferous forests with a beauty all its own."

The large proportion of tannin which the bark contains renders it one of the most useful of our trees, and the many cargoes of this bark which are annually loaded at San Francisco from the northern coast regions would make botanists apprehensive of the early extinction of this beautiful tree, were it not for the knowledge that the stumps left by the bark hunter sprout readily from the base—so continuing the life of the species in the same manner as that by which the Coast Redwood is preserved.

The tan-bark oak is the only representative in America of a peculiar group of trees found in central and eastern Asia, in which are combined the characters of the oak and chestnut; and from this circumstance it suggests, first, a common origin long ago, in the Arctic region perhaps, from whence the two forms have widely diverged; and, second, a lower formative state of the line of development before it became a fully-equipped oak. This species is one of the most interesting inhabitants of the forests of the United States.

The group of chestnut-like oaks to which this species belongs was erected into a sub-genus by Prof. Oersted, and named *Pasania.**

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*The separation of this group of trees from the genus *Quercus* by Oersted, is but in accordance with the progress of botanical science which divides and subdivides, if

10. **Quercus Breweriana.** Engelm, 1880. BREWER OAK.

A low-spreading bush or becoming a small tree, forming thickets on the western slopes of the Sierra Nevada, from near the northern border of the state of California south to Tulare County. On the upper San Joaquin, at an elevation of 5,000 to 6,000 feet, forming vast, almost impenetrable thickets, the slender stems, 12 to 18 feet high, standing for miles as evenly as a field of wheat. Discovered 1862, on a ridge near Mt. Shasta, by Prof. Brewer.* Collected in the vicinity, 1867, by the writer, whose full specimens sent to Dr. Engelmann decided him to regard it as an undescribed species. Prof. Greene refers this to another species, *Q. Oerstediana,* R. Brown, but Prof. Sargent regards this reference as decidedly incorrect.

11. **Quercus Sadleriana.** Brown, 1871. SADLER OAK.

A shrub 3 to 6 feet high, forming extensive thickets on the high slopes of a limited region in northwestern California and southwestern Oregon, mostly on the Siskiyou Mountains. Discovered, 1852, by John Jeffrey, the Scotch gardener, who collected a sterile branch only, while the full characters remained to be discovered by R. Brown, 1862, on the Crescent City trail near the Oregon line. Leaves resembling those of the chestnut, but thinner.

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necessary, the early-named groups as required for exact classification. The small group of trees in question have almost perfect chestnut-like leaves, large, long, and erect staminate flowers, fruit cases or cups clothed with long, half-inch, subulate appendages in place of scales. The nuts are broad and short and often slightly triangular at the apex—these marked characters clearly determining that, as Prof. Greene says, "This peculiar species of tree is as near to the chestnut as to the oak." But as this tree is neither one nor the other, and quite distinct, very properly it may be regarded as entitled to generic rank, when our species would have to be named **Pasania densiflora,** *nom. nov.* California Chestnut Oak.

*Prof. Wm. Henry Brewer was born in Poughkeepsie, New York, 1828. At an early age he showed a fondness for natural scenery and botanical objects, obtained a college education, and early took a chair in the Sheffield Science School, at Yale University, a position he still occupies. In 1860 he was appointed first assistant of the U. S. Geological Survey of California, and came out with a party, of which Prof. J. D. Whitney was chief. California was quite thoroughly explored from 1860 to 1864. Professor Brewer was the first to botanize the High Sierra to any extent, gathering plants and taking notes. He subsequently studied the plants for the Botany of California, issued 1876, by Brewer, Watson, and Gray. Professor Sargent writes of him: "Professor Brewer rendered very important services in elucidating the Flora of California, exploring the high peaks of the Sierra Nevada, the remotest fastnesses of which he explored, crossing and recrossing the passes, rewarded by having one of the highest peaks named Mt. Brewer," and, as a farther title to immortality, the writer would add his name was given to a lovely Weeping Spruce, *Picea Breweriana,* Watson, of which Mr. Thomas Howell, of Sauvis Island, Oregon, gathered full specimens 1885, on the Siskiyou Mountains, but meager specimens (without fruit) had been collected 1863, on the top of Black Butte or Muir's Peak near Mt. Shasta, by Professor Brewer, so the honor of its first discovery came to him.

The writer collected specimens of this species near the locality of the Weeping Spruce, 1887, but a sudden storm of rain prevented their preservation. Prof. Brown named this oak in honor of John Sadler, born 1837, in Scotland, an associate of Prof. Balfour, and in 1862 secretary of the Arboricultural Society of Scotland. He traveled extensively, and made many discoveries of new stations of plants in Great Britain.

12. **Quercus dumosa.** Nutt, 1842. SCRUB OAK.

An intricately-branched shrub with stout stems, forming dense thickets, or in cañons, becoming tree-like, very variable, and several forms have received other names. Western slopes of Sierra Nevada, common south of San Francisco to San Bernardino Mountains, and on the Channel Islands, where it attains its largest size. Var. *revoluta,* Sargent, is the form common north of San Francisco.

This shrub oak, with Brewer's and Sadler's, comprise the small species of oak in California, and complete the number of 13 species of oak found in California and northward.

SOUTHERN OAKS.

MOSTLY IN ARIZONA AND NEW MEXICO.

1. **Quercus Emoryi.** Torrey, 1848. EMORY OAK.

The most abundant oak in Arizona and vicinity, forming a large part of the open forests on the mountain-sides. On low ground becoming a tree 30 to 80 feet high, diminishing to low, scraggy bushes at upper limits. Distinguished by its dark brown bark (which caused it to be at first classed with the black oaks), its rigid branchlets, dark green, oblong, acute, leathery leaves, and its small, narrow, sweet acorns, called by the Mexicans "Bellotas," and gathered in great quantities for food. Discovered, 1846, by Col. W. H. Emory, commanding a government exploring expedition across the continent from Santa Fe to San Diego, collecting 160 species of plants, including this, one of the most beautiful and useful oaks of the region.

2. **Quercus oblongifolia.** Torrey, 1853. EVERGREEN OAK.

Another oak of nearly the same range, especially south of the great plateau of Colorado. Recognized by its pale checkered bark, round compact head, and light blue foliage. In favorable situations becoming trees 20 to 30 feet high. At lower stations it mingles with the dark Emory oak in pleasing contrast. Discovered 1851, by Dr. S. W. Woodhouse, botanist of Capt. Sitgreaves' expedition to the Zuni and Colorado Rivers. Dr. Woodhouse collected animals as well as plants, making a valuable collection preserved in Smithsonian Institute.

3. **Quercus undulata.** Torrey, 1828. ROCKY MOUNTAIN OAK.

This, the easternmost of our western oaks, is found abundantly on the eastern foothills of the Rocky Mountains, forming thickets of vigorous stolons or traveling sprouts 2 to 3 feet high, extending to Utah and southern Nevada, southward to New Mexico and Arizona, where it becomes trees 20 to 30 feet high. Known by its small, wavy, often spinescent leaves. Quite variable, some of its forms receiving distinct names; as, *Q. pungens, Q. Fendleri, Q. grisea, and Q. turbinella.* Discovered by Dr. Edwin James, botanist of Major Long's expedition to explore Rocky Mountains. The doctor's rich collection included also the Rocky Mountain white pine, *Pinus flexilis.*

4. **Quercus Gambelii.** Nuttall, 1848. GAMBEL OAK.

Another of the small oaks of the Rocky Mountains, extending westward to the Wasatch Mountains, of Utah, thence southward in larger forms to New Mexico and Arizona, on the summits of mountains. Distinguished by its large dark green and deeply-lobed leaves, and its dark gray, deeply-fissured bark. Discovered 1844, on the banks of the Rio Grande, by Wm. Gambel, an early student with Nuttall, and botanist of a party that explored largely in the southwest. He joined Capt. Boone's party of gold seekers, 1849, and shared with them in the fatal disaster of imprisonment by an early snowfall in a pass of the Sierra.

Sargent regards Greene's *Q. venustula* as belonging here, a beautiful shrub with less-lobed leaves and very small acorns, on mountains of southern Colorado and northern New Mexico.

5. **Quercus reticulata.** H. & B., 1807. NET-LEAF OAK.

One of the large trees of Mexico, 20 to 30 feet high, that extends in smaller forms into Arizona and New Mexico, as a very showy shrub on high elevations. At once detected by its oblong or nearly round, thick, leathery leaves, which are strongly net-veined beneath, and its generally many-fruited spikes of fruit, 1 to 5 inches long. American specimens first discovered 1874, on Mt. Graham, 9,500 feet altitude, in northern Arizona, by Dr. J. T. Rothrock, and soon after by other explorers, including the writer, on same mountain and on Santa Catalina, Santa Rita, Chirricahua, and Huachuca Mountains. This pretty oak would be a prize if it could be cultivated, and experiments should be made to determine.

6. **Quercus hypoleuca.** Engelm, 1876. WHITE-LEAF OAK.

Another beautiful black oak of Mexico, inhabiting, also, the mountains of Arizona and New Mexico south of the Colorado plateau, where it becomes a tree 20 to 40 feet high. Distinguished by its lanceolate, thick leaves, which are densely clothed beneath with short, white hairs, the veins prominent, often reddish. Discovered 1851, by Charles Wright, one of the most successful botanists of the Mexican Boundary Survey.

The foliage of this and the preceding species is as striking and beautiful as that of any oak in cultivation.

7. **Quercus tomentella.** Engelm, 1877. COTTON-LEAF OAK.

A little-known oak on the Channel Islands of Santa Barbara and the far-distant Guadaloupe Island off the coast of the California peninsula. Found generally in deep, narrow cañons, and threatened with extinction.

Prof. Sargent writes of this oak: "It is possible that this once grew to a large size. The only specimens I saw were on the eastern side of the Santa Catalina Island, south of Avalon, where there is a small grove of stems about 30 feet high, in a circle 11 feet in diameter, evidently shoots from a large tree." Discovered 1875, on a bleak crest of Guadaloupe Island, by Dr. Edward Palmer, the distinguished traveler and collector.

8. **Quercus Arizonica.** Sargent, 1895. ARIZONA WHITE OAK.

This is the most common and widely-distributed white oak of southern Arizona and New Mexico, covering, with the Emory oak, the slopes and cañons of the mountains up to an elevation of 5,000 to 10,000 feet. Long been confounded with the Rocky Mountain oak, but distinctly separated by its pale bark and shapely head of bright foliage, with large leaves net-veined below. "To this tree," Sargent states, "is due much of the beauty of the forest covering Arizona mountains where the Emory oak is the only broad-leaved tree that exceeds it in abundance."

9. **Quercus Toumeyi.** Sargent, 1895. TOUMEY OAK.

This little oak is the most limited and local of any species in the regions of the Pacific slope. Inhabiting one side of a single mountain—Mule Mountain, in Cochise County, southeastern Arizona—it forms stunted open forests between a belt of the Emory Oak and the summit. The small, ovate, thick leaves, the small fruit, and limited station serve to distinguish the species. Discovered 1894, by Prof. Toumey,* and published with a plate by Prof. Sargent the following year.

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*James Wm. Toumey was born in Van Buren Co., Michigan, graduated from Michigan Agricultural College 1889, becoming a year later Assistant Professor of Botany in that institution. Appointed Professor of Botany and Entomology in the University of Arizona at Tucson, 1881. Becoming absorbingly interested in the flora of that territory, he has explored carefully certain little-known regions, rewarded by many important discoveries, crowned by this latest and best. He is now in charge of the Forest Tree Cultivation Bureau at Washington, and has issued instructive bulletins on the subject of tree culture.

Lemmon Herbarium, Oakland, Cal., Dec., 1901.

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